"Vessel designed to collect waste on board without requiring any pumping for this purpose"

The present invention relates to a vessel designed to travel over a surface of a body of water or a waterway, and to collect on board waste that is present close to said surface.

Such vessels are commonly used to rid port waters of waste floating on the surface thereof, such as floating objects or oil slicks.

Most vessels of this type make use of pumping devices which require relatively complicated mechanical, hydraulic and electrical installations and are thus expensive to produce and keep in operation. Moreover, an operator who has the task of checking that such devices are functioning will require good knowledge of mechanics, hydraulics and electricity, and this can only be provided by expensive training.

One of the objects of the invention is to provide a vessel which is capable of collecting waste without using a specific pumping or gathering device, control of which device would require additional actions over and above those required to manoeuvre said vessel.

To this end, according to the invention, a vessel as mentioned in the introductory paragraph is characterized in that it comprises retaining means which are able to trap and retain said waste, and to be activated by creating a water flow channel which is designed to connect a water inlet and a water outlet provided in said vessel, the retaining means being arranged on at least one trajectory of said channel.

The invention thus ensures automatic activation of the retaining means simply by creating a flow of water along the water flow channel which will then direct the various waste present at the water inlet of said channel towards the retaining means, the water outlet returning water that has been "filtered" since it has been freed of said waste.

The retaining means could for example be activated solely by moving the vessel, and would thus not require any particular mechanism or control during operation thereof. All that will be required is for an operator to pilot the vessel and to direct it towards the waste that he wishes to collect, with the vessel picking up said waste as it moves along. The only skill required by the operator in order to carry out such clean-up operations will be the ability to manoeuvre such a vessel under its conditions of use, that is to say in a port, on a river, etc.

According to a first aspect of the invention, the retaining means comprise means of retaining liquid waste which are arranged on a first trajectory of said channel.

The means of retaining liquid waste will make it possible for example to collect oil slicks which are present close to the surface of the body of water or waterway on which the vessel according to the invention is travelling.

With a view to such an application, the vessel according to the invention may also comprise means of heating an upper surface of the water flow channel, said means being designed to fluidify the oil which may be present in the form of clumps or semi-rigid pellets.

According to one particular embodiment of this first variant, the means of retaining liquid waste comprise a

holding tank which is designed to be passed through by the water flow channel when the vessel is moving.

The vessel may also comprise means of regulating the temperature inside the holding tank, which will make it possible to keep the oil contained in the tank in a liquid state, and this will facilitate subsequent emptying of the tank, for example by pumping.

The holding tank may be produced in various ways. It will preferably have:

. an inlet, designed to be connected to the inlet of the water flow channel, formed by an upper edge of said tank and designed to be placed close to the surface of the water, and

. an outlet, designed to be connected to the outlet of said channel, formed by an orifice made in a bottom of said tank and designed to be obstructed by closure means when said tank is full of liquid waste.

Since oil is by its nature lighter than water, it will gradually accumulate in the holding tank described above, and this will allow the water, freed of this oil, to escape via the bottom of said tank, which tank thus makes it possible to collect and store liquid waste without in any way interrupting the flow of water along the flow channel between the water inlet and the water outlet. This flow will be interrupted only when the holding tank is full, that is to say when the vessel cannot collect any more liquid waste on board. Such an interruption to the flow is then brought about by the closure means.

The closure means will preferably comprise a float having at least one surface capable of covering the orifice which forms the outlet of the tank, which float is made of a

material having a density greater than that of the liquid waste and lower than that of water.

This embodiment of the closure means is advantageous in that it allows automatic closure of the holding tank when said tank is full. This is because, since the float is heavier than the oil held in the tank, it will be gradually pushed downwards towards the orifice made in the bottom of the tank as the latter fills with liquid waste. When the tank is full, the float will naturally be pressed against said orifice and will thus close off the outlet of the tank.

According to a second aspect of the invention, the retaining means comprise means of retaining solid waste which are arranged on a second trajectory of said channel.

The retaining means may comprise both means of retaining liquid waste and means of retaining solid waste. The fact that these are then placed on first and second trajectories makes it possible to ensure that the flow of water along one of the two trajectories will not be interrupted solely because the flow of water along the other trajectory is interrupted.

If the means of retaining solid waste are arranged upstream of the water flow channel with respect to the means of retaining liquid waste, the first and second trajectories of said channel may be coincident between the inlet of the channel and an outlet of the means of retaining solid waste.

Such an arrangement of the means of retaining liquid waste and the means of retaining solid waste makes it possible to reduce the size of the vessel while minimizing the risks of premature interruptions in the water flow trajectories.

This is because it is mainly when the means of retaining liquid waste are full of such waste that an interruption to the flow of water occurs, in order to avoid any discharge of this waste towards the water outlet of the vessel. The arrangement of the means of retaining solid waste upstream of the means of retaining liquid waste, with the first and second trajectories diverging downstream of the means of retaining solid waste, makes it possible to ensure that an interruption to the flow of water through the means of retaining liquid waste will not significantly affect the operation of the means of retaining solid waste.

The means of retaining solid waste could be produced in various ways, and could in particular comprise at least one grille arranged across the water flow channel.

The means of retaining solid waste will preferably comprise a first and a second grille which project with respect to one another and are secured to one another so as to form an assembly, which assembly can move with respect to said vessel.

This preferred embodiment of the means of retaining solid waste allows said waste to be collected and stored in an effective manner, and also makes it possible to easily empty the waste out into a container when the vessel is to be unloaded of its waste.

The vessel may be set in motion in many ways, for example by means of an electric propeller motor or a spark ignition motor, such as an outboard motor with adapted flow deflection means. According to a third aspect of the invention, a vessel as described above will also comprise a turbine designed to drive said vessel in motion, which turbine will have an inlet arranged downstream of the outlet of the water flow channel and an outlet designed to

produce a jet of water towards the outside of said vessel, below the surface of the body of water or waterway.

This third aspect of the invention is advantageous in that, since the turbine is placed in the continuation of the water flow channel, said turbine can control the water flow rate in said channel, and in particular can increase this flow rate, which is particularly useful for example during a start-up phase in the course of which, although the movement of the vessel is relatively slow, effective collection of the waste is ensured by a high flow rate brought about by the turbine in the water flow channel.

The outlet of the turbine will advantageously be provided with a deflector which has an adjustable position, which position will determine a direction of the jet of water produced by said turbine.

The deflector will make it possible to manoeuvre the vessel without requiring any other means dedicated to this specific purpose, such as an attached rudder.

In the case where the vessel has a single hull, the water inlet and water outlet may be made in the bow and in the stern of said hull, which will comprise a hollow part defining the water flow channel.

However, according to a fourth aspect of the invention, a vessel as described above will be provided with at least two hulls which are secured to one another and are substantially parallel to one another, a distance separating said hulls defining a width of the water flow channel.

Such a multi-hull structure gives the vessel greater stability and better manoeuvrability, and makes it possible

to produce the water flow channel in a simple manner, said channel being formed naturally between the hulls.

Such a vessel could also comprise a fairing which connects the bottoms of said hulls, a distance separating said fairing from the surface of the body of water or waterway defining a depth of the water flow channel.

The fairing makes it possible to isolate the water flow channel from any eddy coming from below the vessel which could risk disturbing the operation of the retaining means.

This fairing could also be provided with rolling elements such as wheels in order to facilitate the operations of moving the vessel on dry land.

The abovementioned features of the invention, and also others, will emerge more clearly from reading the following description of one example of embodiment, said description being given in relation to the appended drawings, in which:

Fig. 1 shows a schematic perspective representation of a vessel according to one particular embodiment of the invention;

Fig. 2 shows a schematic representation of such a vessel, seen from its port side, in a first operation configuration;

Fig. 3 shows a schematic representation of such a vessel, seen from its port side, in a second operation configuration;

Fig. 4 shows a schematic representation of such a vessel, seen from its port side, in a third operation configuration; and

Fig. 5 shows a schematic representation of such a vessel, seen from its port side, in a fourth operation configuration.

Fig. 1 schematically shows a vessel BAT according to one particular embodiment of the invention. This vessel BAT is designed to travel over a surface of a body of water or a waterway, and to collect on board waste that is present on said surface. The vessel BAT comprises retaining means (MRS, MRL) which are able to trap and retain waste and to be activated by a movement of the vessel. These retaining means (MRS, MRL) are shown in bold lines in the present figure.

In this example of embodiment, the vessel BAT comprises two hulls CQ1 and CQ2 which are secured to one another and are substantially parallel to one another. These hulls define between them a water flow channel which is designed to connect a water inlet EO and a water outlet SO when the vessel BAT is moving, the retaining means (MRS, MRL) being arranged on at least one trajectory of said channel.

The retaining means (MRS, MRL) comprise means of retaining liquid waste MRL which are arranged on a first trajectory of said channel. These means of retaining liquid waste MRL comprise a holding tank CUV which is designed to be passed through by the water flow channel when the vessel BAT is moving.

The vessel BAT in this case comprises means HM for heating an upper surface of the water flow channel, said means being designed to fluidify liquid waste formed by oil which could be present in the form of clumps or semi-liquid pellets. These heating means HM could for example emit electromagnetic radiation EMW in the form of infrared waves

or microwaves, the amplitude and wavelength of which would have to be regulated beforehand in order to ensure that said radiation EMW penetrates to a predetermined depth De, which may for example be between 5 and 15 centimetres.

The vessel BAT will also advantageously comprise means of regulating the temperature inside the holding tank CUV, which means have not been shown here in order not to unnecessarily clutter up the present figure, which regulating means will make it possible to keep the oil contained in the tank CUV in a liquid state, with a view to facilitating subsequent emptying of the tank, for example by pumping. These regulating means could for example consist of electrical resistors integrated in the walls of the tank CUV and designed to be supplied with an electrical current when the temperature inside the tank CUV falls below a predetermined threshold value.

In the embodiment described here, the holding tank CUV has:

. an inlet EL, designed to be connected to the inlet EO of the water flow channel, formed by an upper edge of said tank and designed to be placed close to the surface of the water, and

. an outlet SL, designed to be connected to the outlet SO of said channel, formed by an orifice made in a bottom of the holding tank CUV and designed to be obstructed by closure means (not shown here) when said tank CUV is full of liquid waste.

The means of retaining liquid waste MRL in this case also comprise a funnel ENT which is designed to direct a flow of water towards the holding tank CUV and to thus promote the creation of the first trajectory of the water flow channel.

The retaining means (MRS, MRL) also comprise means of retaining solid waste MRS which are arranged upstream of

the water flow channel with respect to the means of retaining liquid waste MRL. These means of retaining solid waste MRS comprise a first and a second grille GR1 and GR2 which are arranged across the water flow channel, project with respect to one another and are secured to one another so as to form an assembly (GR1, GR2), which assembly can move with respect to said vessel by means of a pivot link with two supports SUP secured to the first and second hulls CQ1 and CQ2, which pivot link allows rotation of said assembly (GR1, GR2) about an axis of rotation A1.

The vessel BAT also comprises a turbine TUR which is controlled by a motor MOT and is designed to drive said vessel in motion, which turbine has an inlet arranged downstream of the outlet SO of the water flow channel and an outlet designed to produce a jet of water towards the outside of said vessel BAT, below the surface of the body of water or waterway.

Fig. 2 schematically shows this vessel BAT, seen from its port side, in a first operation configuration. The elements of this vessel which have already been described above bear the same references and will not be described again. This schematic view nevertheless makes it possible to see a deflector DEF which is provided on the outlet of the turbine controlled by the motor MOT, which deflector DEF has an adjustable position which determines a direction of the jet of water JO produced by said turbine. This schematic view also shows a fairing CAR which connects the bottoms of the two hulls of the vessel BAT.

The vessel BAT is in this case travelling over the surface of a body of water, a level of which is shown by a line NE. In this first configuration, the deflector DEF is in a high position, so that the jet of water JO produced by the turbine is directed towards the rear of the vessel BAT,

which then moves forwards at a speed Vbat. The relative speed of the vessel with respect to the body of water gives rise to a water flow channel which connects the water inlet EO and the water outlet SO. The establishment of this water flow channel is also promoted by the flow of water through the turbine, the flow rate of water in this channel thus being able to be controlled by controlling the motor MOT.

The means of retaining liquid waste MRL are arranged on a first trajectory TRAJ1 of the water flow channel, with the means of retaining solid waste formed by the first and second grilles GR1 and GR2 being arranged on a second trajectory TRAJ2 of said channel.

Since the first and second grilles GR1 and GR2 which form the means of retaining solid waste are arranged upstream of the water flow channel with respect to the means of retaining liquid waste MRL, the first and second trajectories TRAJ1 and TRAJ2 are coincident between the inlet EO of the water flow channel and an outlet of the means of retaining solid waste, which in this case is located between the first grille GR1 and the funnel ENT of the means of retaining liquid waste MRL.

An adjustable sill (not shown here) may be provided upstream of the first and second grilles GR1 and GR2 so as to control the coincident flows of the first and second trajectories TRAJ1 and TRAJ2 as a function of a draught of the vessel BAT, which draught could for example be caused by overloading of said vessel.

All solid waste DS having a size greater than a spacing between two adjacent bars of the first and second grilles GR1 and GR2 is retained by said grilles as the vessel moves along. However, the first and second grilles GR1 and GR2 do not form an obstacle to the passage of liquid elements, and

thus remove only solid waste DS from the water taken in via the water inlet EO. The water present at the outlet of the means of retaining solid waste may contain liquid waste DL close to the surface, said liquid waste being shown here by hatching close to the water level NE, such as oil slicks as is often the case in port waters. This liquid waste DL will be directed along the first trajectory TRAJ1 by the funnel ENT towards the inlet EL of the holding tank, where it will accumulate at the surface since the density thereof is lower than that of water, which water can escape through the outlet orifice of the tank towards the outlet SO of the water flow channel. The creation of the flow along the first trajectory TRAJ1 is also promoted in this embodiment by a Venturi effect generated by the particular shape of the holding tank, which in this case has a surface area that decreases in the depth direction.

The second trajectory TRAJ2 of the water flow channel will also make it possible for water which contains no liquid waste, since it has been taken from a greater depth, to flow between the fairing CAR and the bottom of the holding tank towards the water outlet SO. This second trajectory TRAJ2 will not be significantly disturbed if the first trajectory TRAJ1 is interrupted.

The means of retaining liquid waste MRL comprise closure means which are designed to obstruct the holding tank when the latter is full of liquid waste DL. These closure means in this case consist of a float FL which is made of a material having a density greater than that of the liquid waste DL and lower than that of water, so that it is naturally held in position just below a line of separation between the liquid waste DL and the water which are contained together in the holding tank. This makes it possible to automatically close the holding tank when said tank is full. This is because the float FL will be

gradually pushed towards the orifice made in the bottom of the tank as the latter fills up with liquid waste DL. When the tank is full, the float will be naturally pressed against said orifice and will therefore close off the outlet of the tank.

Fig. 3 shows such a condition in the form of a second configuration, in which the first trajectory TRAJ1 is interrupted on account of the float FL closing off the orifice made in the bottom of the tank of the means MRL of retaining liquid waste DL. In order to prevent said tank from overflowing in the presence of eddy which could cause the water level NE to vary rapidly, a closure flap TF has also been actuated so as to obstruct the inlet EL of the holding tank. The second trajectory TRAJ2 has not been significantly affected by the interruption to the first trajectory TRAJ1, so that water continues to flow into the flow channel connecting the water inlet EO and the water outlet SO, with the vessel BAT continuing to move at the speed Vbat. The continuing existence of this channel, which is obtained by virtue of the second trajectory TRAJ2, makes it possible for the means of retaining solid waste to continue to operate, as shown by the presence of new solid waste DS collected by the first and second grilles GR1 and GR2.

Fig. 4 shows a third possible operation configuration of a vessel BAT according to the particular embodiment described above. In this third configuration, the deflector DEF provided on the outlet of the turbine controlled by the motor MOT is in the low position, so that it interferes with the jet of water JO produced by said turbine by deflecting it towards the front of the vessel BAT. This has the effect of reversing the direction of the speed Vbat of said vessel BAT, and thus of moving said vessel backwards. Such an ability to move backwards is particularly useful in

situations where the vessel BAT has only a small margin to manoeuvre, for example in port installations where the available space is usually occupied as far as possible by ships at the quayside or in the course of docking or departing. The deflector DEF could also consist of an assembly of a port semi-deflector and a starboard semi-deflector, the latter not being shown in the present figure in which only the port semi-deflector can be seen, it then being possible for said semi-deflectors to be controlled separately so as to inflect the direction of the jet of water JO produced by the turbine towards port or starboard.

It should be noted that, even if the direction of movement of the vessel BAT is reversed, as is the case in this third configuration, the flow of water generated by the turbine makes it possible to maintain a sufficient flow rate between the water inlet EO and the water outlet SO in order to keep the means (GR1, GR2) of retaining solid waste DS and the means MRL of retaining liquid waste DL active, with neither of the first and second trajectories TRAJ1 and TRAJ2 then being interrupted, at least until the holding tank for the liquid waste DL is full as mentioned above.

In one very particular configuration, it may even happen that the deflector DEF is oriented so that the jet of water JO produced by the turbine has a vertical direction. The speed Vbat of the vessel BAT with respect to the body of water or waterway will then be zero, once any effect of inertia has dissipated, but the flow rate between the water inlet EO and the water outlet SO will be maintained and will keep the means (GR1, GR2) of retaining solid waste DS and the means MRL of retaining liquid waste DL active, even though the movement of the vessel BAT has been interrupted.

Fig. 5 shows a fourth possible operation configuration of a vessel BAT according to the particular embodiment described

above. In this fourth configuration, the vessel BAT has been docked with a view to unloading the various waste that it has collected on board. For this purpose, the assembly formed by the first and second grilles GR1 and GR2 has been rotated about the axis A1 of the pivot link which connects said assembly (GR1, GR2) to the supports SUP, which pivot link in this example gives said assembly (GR1, GR2) its mobility with respect to the vessel BAT. In other embodiments, the assembly formed by the first and second grilles GR1 and GR2 could be removed completely. The solid waste DS collected and stored by the means of retaining solid waste formed by said first and second grilles GR1 and GR2 is then poured into a skip BEN which in this example is suspended on a mobile hoist PAL. The liquid waste DL contained in the holding tank, the inlet and outlet of which were closed beforehand by the closure flap TF and the float FL respectively, is then removed using an emptying pipe TUY by creating a suction force ASP.

It will be noted that such operations of unloading the vessel BAT may also be carried out on dry land, the lower surface of the fairing CAR of the vessel BAT being provided with rolling elements, in this example a front wheel R1 and two rear wheels R2 and R3, only the port wheel of which can be seen, in order to facilitate operations of moving the vessel BAT on dry land. These rolling elements R1, R2 and R3 will also be very useful for loading said vessel BAT onto a platform or a trailer in order to transport it, for example over land, and also for setting the vessel BAT afloat, since all that will be required then is to roll it along the shore, which omits the need to use a crane.